

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1 Claim 1 (previously presented): A fast-search adaptive motion accuracy
2 search method for estimating motion vectors in motion-compensated video coding by
3 finding a best motion vector for a macroblock, said method comprising the steps of:

- 4 (a) searching a first set of motion vector candidates in a grid of
5 sub-pixel resolution of a predetermined square radius
6 centered on V_1 to find a best motion vector V_2 using a first
7 criteria;
8 (b) searching a second set of motion vector candidates in a grid
9 of sub-pixel resolution of a predetermined square radius
10 centered on V_2 to find a best motion vector V_3 using a
11 second criteria;
12 (c) searching a third set of motion vector candidates in a grid of
13 sub-pixel resolution of a predetermined square radius
14 centered on V_3 to find said best motion vector of said
15 macroblock using a third criteria, and
16 (d) wherein at least one of said first criteria, said second criteria,
17 and said third criteria is a rate-distortion criteria.

1 Claim 2 (original): The method of claim 1, said step of searching a first set
2 of motion vector candidates in a grid of sub-pixel resolution of a predetermined square
3 radius centered on V_1 to find a best motion vector V_2 further comprising the step of

4 searching a first set of eight motion vector candidates in a grid of 1/2-pixel resolution of
5 square radius 1 centered on V_1 to find a best motion vector V_2 .

1 Claim 3 (original): The method of claim 1, said step of searching a second
2 set of motion vector candidates in a grid of sub-pixel resolution of a predetermined
3 square radius centered on V_2 to find a best motion vector V_3 further comprising the step
4 of searching a second set of eight motion vector candidates in a grid of 1/6-pixel
5 resolution of square radius 1 centered on V_2 to find a best motion vector V_3 .

1 Claim 4 (previously presented): The method of claim 1 further comprising
2 the steps of using V_2 as the motion vector for the macroblock if V_2 has the smallest rate-
3 distortion cost and skipping step (c) of claim 1.

1 Claim 5 (original): The method of claim 1, said step of searching a third
2 set of motion vector candidates in a grid of sub-pixel resolution of a predetermined
3 square radius centered on V_3 to find said best motion vector of said macroblock further
4 comprising the step of searching a third set of eight motion vector candidates in a grid of
5 1/6-pixel resolution of square radius 1 centered on V_3 to find said best motion vector of
6 said macroblock.

1 Claim 6 (original): The method of claim 1, said step of searching a third
2 set of motion vector candidates in a grid of sub-pixel resolution of a predetermined
3 square radius centered on V_3 to find said best motion vector of said macroblock further
4 comprising the step of skipping motion vector candidates of said third set of motion
5 vector candidates that have already been tested.

1 Claim 7 (original): The method of claim 1 further wherein said step of
2 searching said first set of motion vector candidates further comprises the step of
3 searching said first set of motion vector candidates using a first filter to do a first

4 interpolation, said step of searching said second set of motion vector candidates further
5 comprises the step of searching said second set of motion vector candidates using a
6 second filter to do a second interpolation, and said step of searching said third set of
7 motion vector candidates further comprises the step of searching said third set of
8 motion vector candidates using a third filter to do a third interpolation.

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1 Claim 8 (previously presented): The method of claim 1, said step of
2 searching a second set of motion vector candidates in a grid of sub-pixel resolution of a
3 predetermined square radius centered on V_2 to find a best motion vector V_3 further
4 comprising the steps of:

- 5 (a) searching three candidates of 1/3-pel accuracy V_2 and a 1/2-
6 pel location with the next lowest rate-distortion cost if V_2 is at
7 the center;
8 (b) searching four vector candidates of 1/3-pel accuracy that are
9 closest to V_2 if V_2 is a corner vector; and
10 (c) determining which of two corners has lower rate-distortion
11 cost and searching four vector candidates of 1/3-pel
12 accuracy that are closest to a line between said corner with
13 lower rate-distortion cost, if V_2 is between two corners
14 vectors.

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1 Claim 9 (previously presented): An adaptive motion accuracy search
2 method for estimating motion vectors in motion-compensated video coding by finding a
3 best motion vector for a macroblock, said method comprising the steps of:

- 4 (a) searching a first set of motion vector candidates in a grid
5 centered on V_1 using a first criteria to find a best motion
6 vector V_2 using a first filter to do a first interpolation;
7 (b) searching a second set of motion vector candidates in a grid
8 centered on V_2 using a second criteria to find a best motion

vector V_3 using a second filter to do a second interpolation;
and

- (c) searching a third set of motion vector candidates in a grid centered on V_3 using a third criteria to find said best motion vector of said macroblock using a third filter to do a third interpolation;
- (d) wherein at least one of said first criteria, said second criteria, and said third criteria is a rate-distortion criteria.

Claim 10 (original): The method of claim 9 wherein said step of searching using a first filter to do a first interpolation further comprises using a simple filter to do a coarse interpolation.

Claim 11 (original): The method of claim 9 wherein said step of searching using a first filter to do a first interpolation further comprises using a simple filter to do a coarse interpolation and said step of searching using a second filter to do a second interpolation further comprises using a complex filter to do a fine interpolation.

Claim 12 (original): The method of claim 11 wherein said step of searching using a third filter to do a third interpolation further comprises using a complex filter to do a fine interpolation.

Claim 13 (original): The method of claim 9 wherein said step of searching using a first filter to do a first interpolation further comprises using a bilinear filter to interpolate the reference frame by 2x2.

Claim 14 (original): The method of claim 9 wherein said step of searching using a first filter to do a first interpolation further comprises using a bilinear filter to interpolate the reference frame by 2x2 and said step of searching using a second filter

4 to do a second interpolation further comprises using a cubic filter to do a fine
5 interpolation.

1 Claim 15 (original): The method of claim 14 wherein said step of
2 searching using a third filter to do a third interpolation further comprises using a cubic
3 filter to do a fine interpolation.

1 Claim 16 (previously presented): An adaptive motion accuracy search
2 method for estimating motion vectors in motion-compensated video coding by finding a
3 best motion vector for a macroblock, said method comprising the steps of:

- 4 (a) searching at a first motion accuracy for a first best motion
5 vector of said macroblock;
- 6 (b) encoding said first best motion vector and said first motion
7 accuracy;
- 8 (c) searching for at least one second best motion vector of said
9 macroblock at an at least one second motion accuracy;
- 10 (d) encoding said at least one second best motion vector and
11 said at least one second motion accuracy; and
- 12 (e) selecting the best motion vector of said first and at least one
13 second best motion vectors using rate-distortion criteria.

1 Claim 17 (original): The method of claim 16 wherein said step of selecting
2 the best motion vector using rate-distortion criteria further comprises the step of said
3 rate-distortion criteria adapting according to the different motion accuracies to determine
4 both the best motion vectors and the best motion accuracies.

1 Claim 18 (original): The method of claim 16, said step of searching for at
2 least one second best motion vector at an at least one second motion accuracy further
3 comprising the step of searching for at least one second best motion vector of said

4 macroblock at an at least one second motion accuracy that is finer than said first motion
5 accuracy.

1 Claim 19 (original): The method of claim 16 wherein said step of selecting
2 the best motion vector using rate-distortion criteria further comprises the step of using
3 rate-distortion criteria of the type "distortion + L*Bits" to select the best motion vector.

1 Claim 20 (previously presented): An adaptive motion accuracy search
2 method for estimating motion vectors in motion-compensated video coding by finding a
3 best motion vector for a macroblock, said method comprising the steps of:

- 4 (a) searching at a motion accuracy for a best motion vector of
5 said macroblock using rate-distortion criteria;
- 6 (b) encoding said motion accuracy using a code from a VLC
7 table that is interpreted differently at different coding units
8 according to the associated motion vector accuracy; and
- 9 (c) encoding said best motion vector in the respective accuracy
10 space.

1 Claim 21 (previously presented): A system for estimating motion vectors
2 in motion-compensated video coding by finding a best motion vector for a macroblock,
3 said system comprising:

- 4 (a) a first encoder for searching a first set of motion vector
5 candidates in a grid of sub-pixel resolution of a
6 predetermined square radius centered on V_1 using a first
7 criteria to find a best motion vector V_2 ;
- 8 (b) a second encoder for searching a second set of motion
9 vector candidates in a grid of sub-pixel resolution of a
10 predetermined square radius centered on V_2 using a second
11 criteria to find a best motion vector V_3 ; and

- 12 (c) a third encoder for searching a third set of motion vector
13 candidates in a grid of sub-pixel resolution of a
14 predetermined square radius centered on V_3 using a third
15 criteria to find said best motion vector of said macroblock;
16 (d) wherein at least one of said first criteria, said second criteria,
17 and said third criteria is a rate-distortion criteria.

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1 Claim 22 (original): The system of claim 21 wherein said first, second,
2 and third encoders are a single encoder.
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1 Claim 23 (previously presented): A fast-search adaptive motion accuracy
2 search method for estimating motion vectors in motion-compensated video coding by
3 finding a best motion vector for a macroblock, said method comprising the steps of:

- 4 (a) searching a first set of motion vector candidates in a grid of
5 sub-pixel resolution of a predetermined square radius
6 centered on V_1 to find a best motion vector V_2 ;
7 (b) searching a second set of motion vector candidates in a grid
8 of sub-pixel resolution of a predetermined square radius
9 centered on V_2 to find a best motion vector V_3 ;
10 (c) searching a third set of motion vector candidates in a grid of
11 sub-pixel resolution of a predetermined square radius
12 centered on V_3 to find said best motion vector of said
13 macroblock, and
14 (d) using V_2 as the motion vector for the macroblock if V_2 has the
15 smallest rate-distortion cost and skipping step (c).
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1 Claim 24 (previously presented): The method of claim 1, wherein said first
2 criteria, said second criteria, and said third criteria are all rate-distortion criteria.
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Claim 25 (previously presented): The method of claim 9, wherein said first criteria, said second criteria, and said third criteria are all rate-distortion criteria.

Claim 26 (currently amended): The system of ~~claim 21~~, claim 21, wherein said first criteria, said second criteria, and said third criteria are all rate-distortion criteria.